



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR**  
(Established by Govt. of A.P., Act. No. 30 of 2008)  
ANANTHAPURAMU – 515 002 (A.P) INDIA

**Course Structure for B. Pharmacy. - R15 Regulations**  
**B. Pharmacy**

**I-II Semester**

S.No	Course code	Subject	Th	Tu/Drg/Lab	Credits	
1.	15R00201	Pharmaceutical Organic Chemistry - II	3	1 - -	3	
2.	15R00202	General & Dispensing Pharmacy	2	1 - -	2	
3.	15R00203	Pharmaceutical Biochemistry	3	1 - -	3	
4.	15R00204	Pharmacognosy – I	2	1 - -	2	
5.	15A52201	English for Professional Communication	3	1 - -	3	
6.	15R00205	Pharmaceutical Organic Chemistry – II Lab	-	- - 4	2	
7.	15R00206	General & Dispensing Pharmacy Lab	-	- - 4	2	
8.	15R00207	Pharmaceutical Biochemistry Lab	-	- - 4	2	
9.	15R00208	Pharmacognosy – I Lab	-	- - 4	2	
			13	5	16	21

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**B.Pharmacy. I - II Sem.**

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<b>Subject</b>	<b>PHARMACEUTICAL ORGANIC CHEMISTRY-II</b>	<b>Course Code</b>	15R00201
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	II
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal exam</b>	30 marks
<b>Credits</b>	3		

**Objectives:**

1. To understand the reactivity of various functional groups.
2. To understand the recent advances in organic synthesis by knowing safe technologies.

**UNIT - I:**

**Alcohols:** Nomenclature, classification, general methods of preparation, physical properties, hydrogen bonding, characteristic nucleophilic substitution reactions (replacement of -OH by -Cl), elimination reactions, and relative reactivities of 1°, 2° and 3° alcohols, Meerwein Ponderff Verley reduction.

**Phenols:** Nomenclature, general methods of preparation, physical properties, acidity of phenols, stability of phenoxide ion, reactions of phenols, Kolbe-Schmidt reaction, Fries rearrangement, and Reimer-Tiemann Reaction.

**Ethers:** Nomenclature, Williamson's synthesis, action of hydro iodic acid on ethers (Ziesel's method).

**UNIT - II:**

**Aromatic Hydrocarbons:**

Kekule Structure of Benzene, Bond Length, Heat Of Hydrogenation, Stability, Molecular Orbital Picture Of Benzene, Aromaticity, Huckel's rule, Nomenclature of benzene derivatives, Characteristic reactions of Benzene, Theory of reactivity and orientation in Monosubstituted Benzenes.

**Aromatic Halogen Compounds:**

Nomenclature, Low reactivity of Halobenzenes towards nucleophilic substitution, Arenes, Benzyne ion Concept.

### UNIT-III:

#### Polynuclear Aromatic Hydrocarbons

Nomenclature, Structure and Aromatic Character of Naphthalene, Anthracene and Phenanthrene resonance structures, electron density and reactivity, electrophilic substitution, oxidation and reduction reactions.

### UNIT - IV:

**Carboxylic acids:** Nomenclature, intermolecular association, stability of carboxylate anion, two important methods of preparation, decarboxylation, functional groups reactions and reduction of carboxylic acids.

**Acid derivatives:** (acid chlorides, anhydrides, esters and amides): Nomenclature, reactions like hydrolysis, reduction of esters and amides, Hofmann's degradation of amides. Brief account of preparation and properties of malonic and acetoacetic esters, their importance in organic synthesis.

### UNIT - V:

**Nitro compounds:** Nomenclature, acidity of nitro compounds containing  $\alpha$ -hydrogens, reductive reactions of aromatic nitro compounds.

**Amines:** Nomenclature, classification, basicity of amines, relative reactivity, Hinsberg method of separation, acylation reactions. Diazotisation and reactions of diazonium salts.

**Nitriles and isonitriles:** Nomenclature, two methods of synthesis, reactivity and functional reactions.

#### TEXT BOOKS

- 1 *Advanced pharmaceutical organic chemistry*, Bahl & Bahl, S.Chand.
1. *Organic chemistry*, T.R.Morrison and R.N.Boyd, Pearson Education India, New Delhi.

#### REFERENCES

- 1 *Organic chemistry*, Bruice 6<sup>th</sup> Edition, Pearson Publisher, 2010.
- 2 *Reactions and Mechanism*, Jerry March, 4<sup>th</sup> edition Wiley Publication.
- 3 *Organic chemistry*, Carey, 8<sup>th</sup> Edition, Mc Graw-Hill.
- 4 *Organic chemistry*, Pillai Orient Longman Publisher.
- 5 *The Fundamentals Principles of Organic Chemistry Vol.I & Vol. II*, I.L.Finar, ELBS/Longman.

#### Course outcomes:

1. The graduate can understand nomenclature and chemistry of various functional groups and chemical properties with their mechanisms. Student can apply green chemical methods for the synthesis of new chemical entities in the view of environment protection.

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**B.Pharmacy. I - II Sem.**

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<b>Subject</b>	<b>GENERAL AND DISPENSING PHARMACY</b>	<b>Course Code</b>	15R00202
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	II
<b>Theory</b>	2 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

**Scope and objectives:** This course is designed to impart a fundamental knowledge on the art and science of formulating different dosage forms. It prepares the students for most basics of the applied field of pharmacy.

**UNIT I Origin and History**

Development of pharmacy, Evolution of Pharmacy education & Pharma industry in India. Origin and development of the Pharmacopoeias, History of Ayurveda, salient features of IP, USP and BP.

**UNIT II Dispensing Pharmacy**

Drug - Definition, Essential characteristics. Dosage form - Definition, Classification, Formulation and purpose. Principles of dispensing, parts of prescription, handling of prescription, general dispensing procedures, source of errors in prescription and care required in dispensing procedures including labeling of dispensed products.

**UNIT III Pharmaceutical calculations**

Weights and Measures, introduction to Latin terms, Percentage calculations, alligation method, proof spirit calculations, displacement value and calculations of isotonicity adjustment. Posology-factors affecting selection of dose & dosage form and calculations of doses.

**UNIT IV Principles involved and procedures adopted in dispensing of the following**

**classes of preparations:**

i) Powders ii) Solutions iii) Mixtures iv) Lotions & liniments v) Suspensions vi) Emulsions and vii) Ointments.

**UNIT V Incompatibilities**

Introduction, classifications, methods to overcome incompatibility.

**TEXT BOOKS**

1 *Dispensing Pharmacy, Cooper & Gunns CBS, Publ. and Distributors New Delhi - (2008).*

2 *Dispensing Pharmacy, R.M Metha, 2006 Vallabh Publication, New Delhi.*

**REFERENCES**

1. *Text Book of Pharmaceutics, E.A. Rawlins, Bentley's ELBS publ.*

2. *Essential dosage calculations -Hospital Pharmacy. Lorria & William, William Hassan.*

## **OUTCOME**

**Upon the completion of the course the student should be able to:**

- a. recognize the formulation aspects of different dosage forms;
- b. do different pharmaceutical calculation involved in formulation;
- c. formulate different types of dosage forms; and
- d. appreciate the importance of good formulation for effectiveness.

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**B.Pharmacy. I - II Sem.**

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<b>Subject</b>	<b>PHARMACEUTICAL BIOCHEMISTRY</b>	<b>Course Code</b>	15R00203
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	II
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	3		

**Scope and objectives:** This course is designed to impart a fundamental knowledge on the biochemistry. It prepares the students for most basics of life and chemistry of living.

**UNIT I: Cell Processes, Bioenergetic and Cellular Reactions**

Bio chemical organization of the cell, molecular constituents of membrane, active & passivetransport process, sodium and potassium pumps, osmoregulation and heamostatis. The concept of freeenergy, determination of change in free energy from equilibrium constant & reduction potential. Production of ATP and its biological significance.Redox reactions, redox potential, the respiratorychain & its role in energy capture & its control.Oxidative phosphorylation & its energetics & E.T.Cmechanism.

**UNIT II**

**Introduction to Bio-Molecules:** Structure, classification, cell and biological functions of carbohydrates, proteins, lipids, nucleic acids (DNA & RNA) vitamins & minerals.

**Enzymes & Co-Enzymes:** Classification, Structure, mechanism of action, properties, factors affecting enzymes action, enzyme kinetics and enzyme inhibitions, repressions with reference to drugaction, Isoenzymes, Coenzymes from Vitamins, Nucleotides and non-nucleotides. clinical importanceof enzymes in treatment and diagnosis.

**UNIT III : Metabolism of carbohydrates**

Metabolic pathway, regulation and significance of the following pathways and cycles: Metabolism ofCarbohydrates: Glycolysis (aerobic and anaerobic), glycogenolysis, gluconeogenesis, Kreb's cycle,HMP &uronic acid pathways, Cori cycle.

**UNIT IV : Metabolism of Lipids and Proteins**

**Lipids :** Alpha, Beta, Gama & Omega oxidations of fatty acids, bio-synthesis of fatty acids,

cholesterol, ketogenesis, Utilization of ketone bodies, Regulation and energetics of Lipid metabolism, Metabolic disorders of lipid metabolism.

**Proteins:** Structure, classification of protein. Classification of aminoacids,

concept of essential and nonessential amino acids and their importance in deamination, Trans-amination, de-carboxylation, Urea cycle. Metabolism of Valine, cystine, cysteine, tryptophan, tyrosine, methionine. Biosynthesis of purines, pyrimidines, proteins. Metabolic disorders of Carbohydrate and protein.

#### **UNIT V: Clinical Biochemistry**

Introduction to clinical biochemistry, Normal values of various biochemical parameters (Blood / or Urine: Glucose, VLDL, LDL etc. total proteins, urea, Minerals, Hormones... etc.) and their abnormal values in diagnosis. Liver function test and kidney function test, OGTT.

#### **TEXT BOOKS:**

1. A.L. Lehninger, Principles of Biochemistry; CBS Publishers and distributors.
2. Harper, Biochemistry McGraw Hill Medical, 28th Edition.
3. Text Book of Biochemistry by Satyanarayana Oxford University Press.
4. J.L. Jain, Fundamentals of Biochemistry S.Chand

#### **REFERENCE BOOKS:**

1. Biochemistry, C.B. Powar & G.R. Chatwal, Himalaya publishing house
2. L. Stryer, Text Book of Bio Chemistry. W.H. Freeman & Co. Ltd. 6th Edition.
3. West, Edward Text Book of Biochemistry; Freeman and company, San Francisco.
4. E.E. Conn and PK Stumpf, Outlines of Biochemistry; John Wiley and sons, New York.

#### **OUTCOME**

**Upon the completion of the course the student should be able to:**

- a. Understand the chemistry involved in life.
- b. Understand biochemical reactions in the human body.
- c. Understand the metabolic pathways of various biomolecules.

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<b>Subject</b>	<b>PHARMACOGNOSY-I</b>	<b>Course Code</b>	15R00204
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	II
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1 hr/week
<b>End exam</b>	70 marks	<b>Internal exam</b>	30 marks
<b>Credits</b>	3		

**Objectives:** This subject has been introduced for the pharmacy course in order to make the student aware of medicinal uses of various naturally occurring drugs its history, sources, distribution, method of cultivation, active constituents, medicinal uses, identification tests, preservation methods, substitutes and adulterants.

**UNIT I**

- A) Definition, history, development and scope of Pharmacognosy
- B) Brief introduction to natural sources of drugs with examples: plants, animals, minerals, marine and microorganisms

**UNIT II**

- A) Classification of drugs of natural origin: Alphabetical, morphological, taxonomical, chemotaxonomic, pharmacological and chemical classification with suitable examples.
- B) Cultivation, collection, processing, drying, and storage of medicinal plants.
  - Factors influencing cultivation of medicinal plants.
  - Plant hormones and their applications.
  - Improved methods of cultivation techniques: polyploidy, mutation and hybridization with reference to medicinal plants.
  - WHO guidelines on Good Agricultural and Collection Practices (GACP) for medicinal plants

**UNIT III**

- A) Introduction, definition, classification, different chemical tests for the carbohydrates and derived products. Systemic Pharmacognostic study of the following carbohydrates and derived products: Acacia, Tragacanth, Agar, Starch, Guar gum, Pectin, Isabgol and Honey.



## UNIT IV

- A) Definition, classification and properties of tannins. Study of tannin containing drugs-Gambir, Black catechu, Galls, Myrobalan and Arjuna.
- B) Study of source, preparation and identification of fibres used in pharmacy like cotton, silk, wool, nylon and polyester.

## UNIT V

Introduction, definition, classification, different physical, chemical properties, extraction methods, chemical tests for the lipids. Systemic Pharmacognostic study of the following lipids: castor oil, cod liver oil, shark liver oil, linseed oil, cocoa butter, kokum butter, bees wax, wool fat, hydnocarpus oil, Rice bran oil and Lard.

### **TEXT BOOKS:**

1. Kokate C.K., Purohit A.P., Gokhale S. B. *Pharmacognosy*, Nirali Prakashan, New Delhi.
2. *Text book of Pharmacognosy by Handa and Kapoor.*
3. *Pharmacognosy by Robert, Tyler.*

### **REFERENCE BOOKS:**

1. *WHO guidelines on good agricultural and collection practices (GACP)- WHO, Geneva*
2. *Cultivation & utilization of medicinal plants by Atal CR and Kapoor BM.*
3. *Text book of Pharmacognosy by Wallis.*
4. *Pharmacognosy by Trease and Evans, latest edition.*
5. *Swain T; Chemical Plant taxonomy, Academic Press London.*

### **Upon completion of the course student shall be able to:**

- a. understand the basic principles and improved techniques of cultivation, collection and storage of crude drugs.
- b. know the scientific name, geographical distribution, chemical nature and uses of crude drugs;
- c. know the significance of carbohydrates, tannins, lipids and fibres in pharmacy.

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**B.Pharmacy. I - II Sem.**

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<b>Subject</b>	English for Professional Communication	<b>Code</b>	15A52201
<b>Course year</b>	B. Pharm. I year	<b>Semester</b>	II
<b>Theory</b>	2 hrs/week	<b>Tutorial</b>	1 hr/week
<b>End exam</b>	70 marks	<b>Internal exam</b>	30 marks
<b>Credits</b>	2		

**1. INTRODUCTION:**

English is a global language and has international appeal and application. It is widely used in a variety of contexts and for varied purposes. The students would find it useful both for social and professional development. There is every need to help the students acquire skills useful to them in their career as well as workplace. They need to write a variety of documents and letters now extending into professional domain that cuts across business and research also. The syllabus has been designed to enhance communication skills of the students of engineering and pharmacy. The prescribed book serves the purpose of preparing them for everyday communication and to face the global competitions in future.

The text prescribed for detailed study focuses on LSRW skills and vocabulary development. The teachers should encourage the students to use the target language. The classes should be interactive and learner-centered. They should be encouraged to participate in the classroom activities keenly.

In addition to the exercises from the text done in the class, the teacher can bring variety by using authentic materials such as newspaper articles, advertisements, promotional material etc.

**2. OBJECTIVES:**

1. To develop confidence in the students to use English in everyday situations.
2. To enable the students to read different discourses so that they appreciate English for science and technologies.
3. To improve familiarity with a variety of technical writings.
4. To enable the students to acquire structure and written expressions required for their profession.
5. To develop the listening skills of the students.

### **3. SYLLABUS:**

#### **UNIT –I**

**Topics:** Group discussion, cause and effect, events and perspectives, debate, if conditional, essay writing.

**Text: LESSONS FROM THE PAST** from *MINDSCAPES*

Importance of History - Differing Perspectives - Modern Corporatism - Lessons From The Past

#### **UNIT-II**

**Topics:** Idioms, essay writing, power point presentation, modals, listening and rewriting, preparing summary, debate, group discussion, role play, writing a book review, conversation

**Text: ‘ENERGY’** from *MINDSCAPES*

Renewable and Non-Renewable Sources - Alternative Sources -Conservation -Nuclear Energy

#### **UNIT-III**

**Topics:** Vocabulary, impromptu speech, creative writing, direct and indirect speech, fixed expressions, developing creative writing skills, accents, presentation skills, making posters, report writing

**Text: ‘ENGINEERING ETHICS’** from *MINDSCAPES*

Challenger Disaster - Biotechnology - Genetic Engineering - Protection From Natural Calamities

#### **UNIT-IV**

**Topics:** Vocabulary, Conversation, Collocation, Group discussion, Note-making, Clauses, Interpreting charts and tables, Report writing.

**Text: ‘TRAVEL AND TOURISM’** from *MINDSCAPES*

Advantages and Disadvantages of Travel - Tourism - Atithi Devo Bhava - Tourism in India

#### **UNIT-V**

**Topics:** Vocabulary, phrasal verbs, writing a profile, connectives, discourse markers, problem-solving, telephone skills, application letters, curriculum vitae, interviews (telephone and personal)

**Text: ‘GETTING JOB-READY’** from *MINDSCAPES*

SWOT Analysis - Companies And Ways Of Powering Growth - Preparing For Interviews

**Prescribed Text**

**MINDSCAPES:** English for Technologists and Engineers, Orient Blackswan, 2014.

**REFERENCES:**

1. **Effective Tech Communication**, Rizvi, Tata McGraw-Hill Education, 2007.
2. **Technical Communication**, Meenakshi Raman, Oxford University Press.
3. **English Conversations Practice**, Grant Taylor, Tata Mc GrawHill publications, 2013.
4. **Practical English Grammar**. Thomson and Martinet, OUP, 2010.

**Expected Outcomes:**

At the end of the course, students would be expected to:

1. Have acquired ability to participate effectively in group discussions.
2. Have developed ability in writing in various contexts.
3. Have acquired a proper level of competence for employability.

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<b>Subject</b>	<b>PHARMACEUTICAL ORGANIC CHEMISTRY-II LAB</b>	<b>Course Code</b>	15R00205
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	II
<b>Practical</b>	4 hrs/week	<b>Tutorial</b>	NIL
<b>End exam</b>	50 marks	<b>Internal</b>	25 marks
<b>Credits</b>	2		

**I. Experiments:**

A. Preparation of organic compounds (each involving a specific organic reaction covered in theory- any 10 synthesis)

1. Sulphonation : Preparation of Toluene para sulphonic acid from toluene.
2. Bromination : Tribromoaniline from Phenol or Aniline.
3. Addition/Elimination : Preparation of phenyl hydrazone or oxime from Benzaldehyde.
4. Addition : Preparation of 2,3-dibromo-3-phenyl propionic acid from cinnamaldehyde.
5. Dehydration : Preparation of acetonedicarboxylic acid from citric acid
6. Condensation : Preparation of dibenzalacetone from benzaldehyde

**B.** Identification of the following organic compounds by systematic qualitative analysis including acidic/basic/neutral character, aromatic/aliphatic, saturated/unsaturated, test for special elements and functional group identification tests.

- a. Phenols
- b. Amides
- c. Amines
- d. Carboxylic acids
- e. Aldehydes and Ketones
- f. Alcohols
- g. Anilides and nitrocompounds
- h. Esters

**II. Demo / work shop**

Crystallization by using various solvents, atomic models emphasizing organic molecules & TLC for synthesized compounds.

**III. Seminar/assignment/group discussion**

Exercise on nomenclature of compounds, Knowledge on Protection of groups by green chemical methods, microwave assisted synthesis.

**REFERENCES**

1. Text Book of Practical Organic Chemistry, Vogel's, 5<sup>th</sup> Edition Pearson.
2. Laboratory Manual of Organic Chemistry, R.K. Bansal, New Age International 5<sup>th</sup> Edition 2007.
3. Advanced Practical Organic Chemistry, O.P. Agarwal, 3<sup>rd</sup> Edition Goel Publication.
4. Practical Organic Chemistry, F.G.Mann & B.C. Saunders, Pearson 4<sup>th</sup> Edition.

## **LIST OF MINIMUM EQUIPMENT REQUIRED**

1. Triple beam balances
  2. Physical balances
  3. Melting point apparatus
  4. Suction pumps
  5. Oven
  6. Hot plates
  7. Water baths
  8. Distillation unit
  9. Refrigerator
- Adequate glassware

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**B.Pharmacy. I - II Sem.**

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<b>Subject</b>	<b>GENERAL AND DISPENSING PHARMACY LAB</b>	<b>Course Code</b>	15R00206
<b>Course year</b>	B. Pharmacy I year	<b>Semester</b>	II
<b>Theory</b>	4hrs/week	<b>Tutorial</b>	Nil
<b>End exam</b>	50 marks	<b>Internal</b>	25marks
<b>Credits</b>	2		

**I. EXPERIMENTS**

- Dispensing of prescriptions falling under the categories: Mixtures, syrups, solutions, emulsions, ointments, powders, lotions, liniments (minimum two prescriptions from each class).
- Identification of physical, chemical and therapeutic incompatibilities in a prescription, and dispensing of such prescriptions (3 Exercise).
- Dispensing procedures involving pharmaceutical calculations, and dosage calculations for paediatric and geriatric patients

**II. DEMO/WORKSHOP**

Demo on homogenizer and identification test for emulsions.

**III. SEMINAR/ASSIGNMENT/GROUP DISCUSSION**

- Current status of Indian pharma industry.
- Applications of various dosage forms.

**REFERENCE:**

- Dispensing Pharmacy, Cooper & Gunns CBS, Publ. and Distributors New Delhi – (2008).
- Dispensing Pharmacy, R.M Metha, 2006 Vallabh Publication, New Delhi.

**LIST OF MINIMUM EQUIPMENT REQUIRED**

Adequate number of the following, such that each student gets

- Mortars and pestles.
- Analytical balance and weight box.
- Percolators.
- Dispensing containers.
- PH meter.
- Electronic balance.
- Adequate quantities of chemicals and glassware.

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<b>Subject</b>	<b>PHARMACEUTICAL BIOCHEMISTRY LAB</b>	<b>Course Code</b>	15R00207
<b>Course year</b>	B. Pharm I year	<b>Semester</b>	II
<b>Theory</b>	3 hrs/week	<b>Tutorial</b>	1hr/week
<b>End exam</b>	70 marks	<b>Internal</b>	30 marks
<b>Credits</b>	2		

**I. EXPERIMENTS:**

1. To prepare standard buffers (citrate, phosphate & carbonate) and measure the pH.
2. Separation of amino acids by gel / paper electrophoresis.
3. Identification of carbohydrates
4. Identification of amino acids.
5. Identification of lipids.
6. Estimation of glucose in urine and blood.
7. Estimation of creatinine in urine.
8. Estimation of creatinine in blood.
9. Estimation of cholesterol in blood.
10. Estimation of Urea in Blood
11. Estimation of Serum protein.
12. Estimation of bile pigments in serum.
13. Estimation of alkaline phosphatase, SGOT, SGPT in serum
14. Effect of temperature on the activity of alpha-amylase.

**NOTE:** Collection of blood samples from human should be carried out by trained pathologist and subject as per norms from the human subject.

**II. WORKSHOP / DEMO**

Different diagnostic methods in diagnostic lab, Blood Glucose estimation by Glucometer

**III. SEMINAR / ASSIGNMENT / GROUP DISCUSSION**

Various diagnostic tests for different diseases, Gene therapy and gene targetting

**LIST OF MINIMUM EQUIPMENTS REQUIRED**

1. Colorimeter
2. Table top centrifuge
3. Digital balance
4. Physical/chemical balance
5. pH meter
6. Water bath
7. Folin-Wu tubes
8. Autoanalyser
9. Adequate glass wares



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<i>Subject</i>	<b>PHARMACOGNOSY-I LAB</b>	<i>Course Code</i>	15R00208
<i>Course year</i>	B. Pharmacy I year	<i>Semester</i>	II
<i>practical</i>	4 hrs/week	<i>Tutorial</i>	NIL
<i>End exam</i>	50 marks	<i>Internal</i>	25 marks
<i>Credits</i>	2		

**EXPERIMENTS:**

1. Collection and preparation of herbarium/laminated photos/ specimens of natural drugs.
2. Study of microscope.
3. Study of various morphological characters of the drugs mentioned in theory under carbohydrates.
4. Study of various morphological characters of the drugs mentioned in theory under lipids.
5. Study of various morphological characters of the drugs mentioned in theory under tannins.
6. Study of various morphological characters of the drugs mentioned in theory under fibres.
7. Chemical tests for Acacia, Tragacanth, Guar gum, Agar and Starch.
8. Chemical tests for Castor oil, Linseed oil, Shark liver oil, Cod liver oil.
9. Chemical tests for Gambir, Black catechu.
10. Chemical test for fibres mentioned in theory.
11. Determination of swelling factor of mucilage containing herbal drug.

**Seminar/ Assignment:**

Seminar/ Assignment related to theory:

**Workshop/Demo**

Cultivation of medicinal plants

**References**

1. Practical Pharmacognosy, C K Kokate, Nirali Prakashan
2. Practical Pharmacognosy, Khandelwal, Nirali Prakashan
3. Practical Pharmacognosy Iyengar, Manipal Press Ltd.
4. Brain KR and Turner TD. The practical Evaluation of Phytopharmaceuticals, Wright-Scientechics, Bristol.
5. Peach K and Tracey MV, Modern methods of Plant analysis, Narose publishing house, New Delhi.

**LIST OF MINIMUM EQUIPMENTS REQUIRED**

1. Microscopes with stage
2. Heating mantle
3. Water baths
4. Adequate glass wares